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Public interest in frozen foods has increased rapidly in recent years. This is true not only for commercially frozen products, but also for those prepared in the home and held in frozen locker storage. Also, a number of manufacturers of refrigeration equipment are making small freezers which may be used for the freezing and storing of foods in the home. In view of the extremely rapid growth of the frozen food industry, the locker plants, and the so-called farm freezer, a consideration of the basic principles of preservation by freezing has been undertaken in this bulletin.

Freezing has become a highly preferred method of preserving many foods, not only because it is a satisfactory, sanitary, and economical method, but also because it is quick and easy for the homemaker, and in addition, frozen foods come out of storage prepared for cooking or serving. Freezing of foods is important in that products possessing fresh qualities are made available at unusual times and places at practically usual prices. Properly handled frozen meat, fish and vegetables when cooked compare favorably with fresh ones. Frozen foods retain more nutritive value than do those preserved by any other method. Nevertheless, unless foods are carefully handled before freezing, some of their value may be lost in preparation.

PRODUCTS SUITED FOR PRESERVATION BY FREEZING

Freezing, contrary to canning, does not prevent spoilage of food by killing microorganisms except in rare cases, but it does prevent undesirable changes in food through microorganisms, enzymes and cell respiration by lowering their activities to a minimum. Since all these processes develop more easily and possess higher activity in food products after harvesting, it is important to maintain cleanliness during preparation and complete the freezing process as soon as possible after harvesting.

Not all food products are suitable for freezing. In general, vegetables which are commonly served raw as a salad are unsuitable for freezing because freezing (together with blanching) impairs the fresh flavor and destroys crispness. This is the case with cantaloupes, celery, cress, cucumbers, endive, lettuce, green onions, parsley, radishes, green peppers, tomatoes and watermelons. Because of other methods of preservation that are peculiarly suited to them, many vegetables are not recommended for freezing. These include artichokes, cabbage, herbs, onions, hot peppers, white potatoes and rutabagas. Vegetables especially suitable for freezing are peas, beans, corn, spinach, collards, turnip greens and kale. Carrots, parsnips, asparagus, cauliflower, mushrooms, rhubarb and beets are also suitable for preservation by freezing.

The characteristics of fruits which influence freezing qualities are stability of color and flavors on exposure to the air. Most fruits are

well suited to preservation by freezing. In those instances where whole fruits do not give a satisfactory frozen product, better results are obtained in the form of slices or pulp. Pears and bunch grapes are almost the only fruits that are not recommended for freezing. On the other hand, there appears to be little or no justification for the freezing storage of bananas, citrus fruits, and prunes of the dry varieties, as there are other means of preservation equally satisfactory.

Freezing preservation is the only commercial method of keeping the fresh qualities of juices. The process of preserving acid juices in most cases is simpler and less expensive than preserving the product itself. Apple juice, citrus fruit juices, grape juice, the juices of various berries, and the juice of tomato and rhubarb are considered acid juices.

The fact that freezing storage preserves the natural fresh qualities of meats for longer periods of time than other commonly used methods is the specific reason that freezing of meat is so extensively used at present. Besides, freezing meat kills nematodes, tapeworms, and a high percentage of bacteria, and by the formation of ice in the tissue helps in tenderizing it. Other products which are usually preserved by freezing are fish, poultry, game, milk products and eggs. Details on their methods of preservation will be given later in this bulletin.

FREEZING METHODS

The length of time required for food to become frozen solid depends upon method of freezing, type and size of container, nature of product being frozen, and quantity placed in the freezer at one time. Methods range from slow freezing such as that accomplished by the ordinary mechanical refrigerator or freezer locker to very rapid freezing by immersion in a freezing liquid (brine or sugar solution). The main difference in foods frozen at different rates is in the size of ice crystals formed within the tissues. Slow freezing induces the formation of large crystals. By slowing down the rate of freezing, ice crystals may be increased in size as much as 500 times and the larger ones may range up to 1,000 times the size of the cells. The formation of large crystals results in an enormous amount of crushing and rupturing of cells and upon thawing makes the food soft, increases the loss of juice by drip or leakage and creates favorable conditions for enzymes to act upon cell contents, causing changes in color and flavor of the product. Firmness, low leakage and retention of color and flavor are desirable qualities for a food preserved by freezing, and these can better be accomplished with quick freezing. An exception is the case of fruits packed with sugar. Here quick freezing as actually practiced, has little advantage over slower methods because of the need for sugar penetration into the fruit. Since the purpose of this bulletin is to explain home freezing, it will not deal with the various processes of quick freezing as they are applied by the industry, but will give directions for the freezing operation, and preparation of the products to be frozen, in individual freezers or in the local frozen food locker plants.

The simplest type of locker plant is that which offers only cold stor-

age service. The customer places the food to be frozen directly in the locker and allows it to freeze and remain there until it is desired for use. A better arrangement is one in which the locker operator maintains a sharp freezer (a room held at 0° to —10° F.) in which the foods are frozen prior to placement in the lockers. Many locker plants of this type offer butchering, meat cutting, packaging, and freezing services, but very few have services for preparation and packaging of fruits and vegetables.

A number of types of farm freezers are being used. These vary from rather large "walk in" freezers to refrigerated cabinets as small as $2\frac{1}{2}'x2\frac{1}{2}'x7'$. Many of the "walk in" types of freezers have an outer room maintained at a little above freezing which is used for cool storage of fresh fruits, vegetables, and dairy products. The cabinet type is the size which appeals to most farmers and homemakers. The simplest type of cabinet consists of a rectangular, insulated box maintained at approximately 0° F. by means of a small refrigeration unit. This type has the disadvantage of causing the previously frozen stored foods to thaw partially while fresh foods are being frozen, if the fresh foods to be frozen are placed in the same cabinet. In some cabinets this condition is avoided by having two separate compartments, one for freezing and another for storage. Usually a somewhat lower temperature is maintained in the freezing compartment than in the section in which the products are stored. Some two-compartment cabinets have been constructed in which forced air circulation is provided in the freezing compartment. This materially increases the rate of freezing and insures a uniform temperature throughout the freezing compartment, provided the products are not solidly packed in the freezer. Another type of freezer has one or more refrigerated metal plates on which the products are placed for freezing. Since it is accepted that quick freezing is always the best, the two-compartment freezers and locker plants provided with a sharp freezer offer better conditions for freezing, if the temperature of the freezing units is sufficiently low to secure a satisfactory quick freezing. But it should be kept in mind that the rapidity with which a product freezes does not necessarily depend on the temperature of the freezer alone. Some of the other factors that affect the rapidity with which a given product freezes are: size, shape and arrangement of packages, air circulation, contact with the metal freezer plate, previous treatment, temperature of the product to be frozen, and quantity of the food to be frozen at one time. By combining all these factors in the most favorable combination for quick freezing, best results can be obtained from any type of freezer. Starchy foods as peas, corn, and lima beans show very little drip; therefore rapid freezing in these products is not as important as with the non-starchy products. Although higher temperatures may prove satisfactory for freezing certain foods, in most cases a temperature of —25° F. is needed and should be preferred if available. In general, storage temperatures above 0° F. have not proved satisfactory for the preservation of many products for long periods of time as rancidity may develop in the fat in pork meat and loss of color and vitamin C in fruits and vegetables may occur.

Fluctuating temperatures in frozen storage where meat and poultry are maintained, cause a rapid deterioration of the quality of the products because these fluctuations speed up dessication, or loss of moisture. They also accelerate crystal growth in the frozen product and consequently increase drip or leakage when the product is thawed. Fluctuation in temperature is caused by limited area of cooling coils, frequent opening of the door, poor insulation, overloading with food to be frozen and power or mechanical failure. The storage cabinet or locker should not be opened during a power failure. Usually the cabinet is well insulated so that the food does not thaw if the freezing machinery is out of operation for 12 to 72 hours. If a long, continued power failure is expected, dry ice may be procured from the nearest ice cream manufacturer. Fifty pounds of dry ice will prevent thawing in a home freezer for a day or two.

The size of the storage cabinet varies greatly according to the needs or size of the family. In general, an eight cubic feet capacity freezer for the average farm family is considered sufficient. In one cubic foot of space there can be stored about 35 to 45 pounds of food. The cost of operation per year of one 15 cubic foot size cabinet stored in a cool cellar was $16.50, the power consumption averaging about 125 kilowatt-hours per month.

CONTAINERS

In selecting containers for packaging foods to be frozen, the most important considerations are that they be practically moisture-vapor-proof, odorless, and tasteless. Paraffined cardboard cups and tubs are in common use for frozen foods, particularly for foods packed in brine or syrup. Various types of cartons with or without cellophane or moisture-vapor-proof bags are also used (Figure 1). When additional moisture-vapor-proofness is desired, an overwrap of heavy waxed paper may be applied to the rectangular carton. This overwrap, as well as the bag, is sealed with a hot iron (Figure 2). When the food is to be stored only a short time, the container is less important. The cellophane bag alone may be used if there is little handling which might cause tearing. Ordinary waxed paper is not suitable for wrapping foods to be frozen.

Glass jars may be used as containers for frozen foods. It is best to use them for fruit or a food that will be thawed before its removal from the container. Old lids with rubbers are satisfactory, as a perfect seal is not necessary. Allow at least one to one and one-half inch headspace for expansion of the food on freezing.

Tin cans are another possibility for packing foods for freezing. As in canning, use enamel lined cans for colored foods.

Meat, poultry and game are wrapped in locker paper or cellophane. Butcher paper does not give adequate protection from moisture loss or exposure to air. Stockinette material, sold in pound rolls, makes a good covering for cellophane or locker paper as it keeps the wrapping material tight against the food. The preferred method of wrapping meat when vapor-proof paper or cellophane is used is the drugstore or con-

FIGURE 1. Packages for Frozen Fruits and Vegetables

FIGURE 2. Sealing a Cellophane Bag Containing Strawberries

fectioner's wrap. The meat is placed in the center of a square piece of paper large enough to make a locked fold of two opposite sides. The ends are folded twice so that the folds are locked and no air pockets are left. String or gummed tape is passed over the ends to hold the paper together and against the meat. If locker paper, which is less vapor-proof, is used, the butcher's wrap is desirable, as there are more layers of paper for protection. To pack, place paper on table in a diagonal position with a point toward the person wrapping meat and with waxed side up. Place meat in center, bring lower point of paper over meat, then the two side points to the center, and roll meat tightly in paper. Fasten securely with string or gummed tape.

GENERAL CONSIDERATIONS IN THE PREPARATION OF FOOD FOR FREEZING

Products should be selected at the best stage of maturity for serving or cooking. The object of freezing at low temperatures is to stop all the natural life processes and hold the product as nearly as possible in the state in which it enters the freezer. Freezing of course will not improve a poor product. Fruits and vegetables for freezing should be selected for freshness, appearance, flavor, texture and adaptability for freezing under local conditions. They should be sorted and washed, and all nonedible parts removed as is done in preparation for the table. They should be prepared ready to serve or cook without further handling, especially if they are to be cooked without thawing. They should be harvested when mature, fully colored and flavored, but not overripe, mushy, or moldy.

All vegetables must be blanched (scalded) before freezing except sweet peppers and rhubarb, which, on account of their acidity, are classed with the fruits. Blanching is necessary in order to stop the natural processes of growth and decay. These life processes are greatly retarded by freezing but cannot be checked completely unless the enzymes have been inactivated by heat. If the vegetables have not been thoroughly blanched, they will soon lose their attractive color and develop unpleasant flavor and odor. Although harmless to health, the product becomes as undesirable for food as any aged and faded fresh vegetable. Blanching produces a brighter color, softens the product, and makes packing easier. Some unblanched vegetables also become tough in storage. The time of blanching varies with the product. In general one to two minutes in boiling water or several minutes in steam is needed. The temperature of blanching should not be lower than 185° to 194° F. Some products, such as corn and peas, deteriorate rather easily after blanching, while others, such as carrots and asparagus, are more resistant. The best insurance of quality vegetables is an adequate blanching.

The greatest hazard in home freezing is in overloading the freezer, since, in such case, food may actually begin to spoil before it becomes frozen or cooled to the point where bacterial growth is retarded. Over-

loading may also result in thawing of products already frozen and in storage in the same cabinet.

The question of refreezing of foods already thawed should also be considered here, since it can happen as a result of damage to the supply of current or in the function of the freezer. This point is important not only from the standpoint of the nutritive value of the food but also from the point of health, since refrozen completely defrosted vegetables and shellfish are likely to harbor food spoilage microorganisms which produce toxin even at relatively low temperatures. In regard to home-frozen foods, there is no reason why thawed fruits should not be refrozen for later consumption. Meats, poultry, fish and vegetables are not acid and are consequently subject to putrefactive spoilage. It is unwise to refreeze either vegetables or shellfish which have become completely defrosted. Meat, poultry and fish may be either eaten immediately or refrozen without danger, provided the temperature of these products has not at any time exceeded 50° F.

Sliced fresh peaches, apricots and apples darken very rapidly on thawing. For this reason such products may require treatment with sodium sulfite or ascorbic acid or may require blanching to retard or inactivate oxidizing enzymes.

THAWING AND COOKING FROZEN FOOD

If frozen fruit is to be cooked before using, it need not be thawed. Berries for desserts are served while a little ice still remains in the fruit. Such fruits as peaches, apricots and apples require more thawing than do berries. Fruit for pie and cobbler must be thawed enough to spread, and fruit for shortcake, pudding and ice cream must be partially thawed. During thawing, fruit should be left in the unopened, original container.

Thin steaks, chops and cutlets may be cooked without thawing, but steaks as thick as one and one-half inches should be either partially or completely thawed. Pork that contains much fat is better cooked without thawing in order to avoid development of an early state of rancidity. Poultry should be at least partially thawed before cooking, and fish may be completely or partially thawed. To thaw fish, place the unopened container in the refrigerator, because there is less leakage with slow thawing. Fish should be cooked while still chilled, because it spoils quickly. Eggs, milk, butter, cream and cheese should be thawed completely and used as when fresh.

Vegetables in the frozen state are usually added to a small amount of boiling water and cooked from one-third to one-half as long as fresh ones. If they were packed in brine, some thawing is necessary, as the liquid frozen with the vegetable serves as the cooking water. Asparagus and broccoli, which are cooked in less than enough water for covering, may be thawed enough to break the stalks apart. Greens should be cut or broken into pieces so that uniform cooking takes place. It is necessary to thaw corn on the cob; otherwise the kernels will be cooked before the

cob is thawed. Frozen vegetables are partially thawed by allowing them to stay in the sealed container about one hour at room temperature or four hours in the refrigerator. Partial thawing reduces the cooking time, as less time is required for the water to boil again after they are added. Completely thawed vegetables shrink while cooking and are generally less attractive. They may also have changes in flavor and less ascorbic acid (vitamin C) than do the ones cooked without thawing or after partial thawing. To obtain the best product in regard to palatability and nutritive value, use a small amount of water and avoid overcooking frozen vegetables.

When frozen vegetables are cooked in a pressure saucepan they should be thawed enough to be broken apart; otherwise, because of the short cooking period at a high temperature, the center of the block may still contain ice crystals after the outside is cooked. Use only enough water to keep the vegetable from burning; because of the frost on frozen vegetables this amount is about two-thirds as much as for fresh vegetables. The time of cooking varies with the vegetable and the individual's taste. In general, frozen vegetables are cooked one-third to one-half as long as fresh ones.

Since foods when frozen require a shorter cooking time than when fresh, they may be as high in nutritive value as when cooked fresh, because of smaller cooking losses. Frozen vegetables after cooking contain greater quantities of vitamins than canned vegetables, and considerably greater quantities than cooked dehydrated vegetables.

CARE OF THE HOME FREEZER UNIT

It is not necessary to defrost a freezer as often as a regular refrigerator. Usually two to three times a year is sufficient. To defrost, lift up the covers and scrape off the frost. Scoop it out with a dust pan and wipe with a towel. At least once a year, when the food supply in the freezer is low, the locker should be cleaned. First, remove all packages and put them in the freezing compartment of the home refrigerator, or pack the packages in a lined box in which some dry ice has been placed. Then turn off the electricity and open the freezer, allowing it to warm up. Wash out the freezer with a solution containing two tablespoons of baking soda to one quart of water. Do not use soap. Allow the freezer to remain open until thoroughly dry. When the freezer is dry, close the door and turn on the electricity. Replace the packages when the temperature is near 0° F.

PREPARATION OF VEGETABLES FOR FREEZING

Vegetables for freezing are prepared as for cooking, blanched and packed dry or with brine. Vegetables should be harvested while they are at their peak of flavor and appearance. It is better to use them slightly immature than overripe as the latter become tough in texture and rapidly lose flavor.

Blanching is necessary for practically all vegetables in order to stop enzyme action, which causes the food to be less attractive and of lower

TABLE 1. Preparation and Scalding or Blanching Time in Boiling Water* for Vegetables To Be Frozen‡

Vegetable	*How to Prepare*	*Scalding Time (Minutes)*
Asparagus	Cut into lengths to fit package or in 1-inch lengths	Small spears 3 1/2 Medium spears 4 Large spears 4 1/2
Beans, green	Pick when filled but before becoming dry	1
Beans, Lima	Pick when pods are well filled but when seeds are green	Large seeds 2 Small seeds 1
Beans, snap	Use young tender beans. Snap ends and cut into 1-inch lengths	2 1/2
Beans, Soy	Scald pods containing beans to simplify shelling. Shell	Scald to remove seeds 2 1/2
Beets	Remove tops and roots, slice or dice. Mature beets should be cooked, then peeled and sliced	Under 1 1/2 in. diam. 2 1/2 Over 1 1/2 in. diam. Cook until tender
Broccoli	Select compact heads (without blooms) cut in 1-in pieces	Small 3 Large 5
Brussels sprouts	Select dark green compact heads	Medium 4 Large 5
Carrots	Select young tender carrots, cut in 1/4-in. slices	3
Cauliflower	Choose solid white heads, cut in 1-in thick pieces	Small pieces 3 Medium pieces 4
Chinese cabbage	Cut crosswise of head to 1-in. thick slices	1 1/2†
Corn on cob	Husk and eliminate over-and under-mature ears, trim tips	Small ears 6 1/2 Medium ears 8 1/2 Large ears 10 1/2
Corn, cut	Choose corn before starchy and hard but not soft. Scald corn on cob, then cut corn from cob	3
Eggplant	Peel, slice 1/3 in. thick	4
Kale	Select young tender plants, use leaves only	1 1/2
Mustard	Discard stalk and use only tender leaves	1
New Zealand Spinach	Young tender leaves only	1 1/2
Okra	Remove stem, freeze whole or slice after scalding	2-3
Peas	Shell, and discard hard starchy peas	1
Peas, field	Shell, and discard dried ones	1
Pumpkin	Peel, cut, cook in pressure cooker or in covered kettle on rack over water	Cook until done
Spinach	Use tender leaves	1 1/2
Squash, summer	Use young squash, slice 1/2 in. thick	3 1/2

Vegetable	*How to Prepare*	*Scalding Time (Minutes)*
Squash, winter	Peel and cut in pieces	Cook until done
Swiss chard	Select tender leaves	2
Turnip greens	Select young, tender leaves only	1
Turnip roots	Choose tender roots, peel and dice 1/2-in. cubes	1 1/2

*After scalding for the time indicated, vegetables should be cooled immediately by immersing in cold running water.

†Cool in 2 per cent citric acid solution to prevent discoloration.

‡Adapted from table by Clarence W DuBois, "Freezing Fruits and Vegetables," *Electricity on The Farm,* August, 1943.

nutritive value. The two methods of blanching are immersion in boiling water and by steam. Since facilities for blanching in live steam are not available in the home, the hot water method is recommended. Scalding in hot water saves time and insures a more uniform product.

For the boiling water method of blanching, the kettle must be large enough to hold at least one gallon of water per pound of produce; more water is desirable for bulky vegetables such as greens. Place vegetables in a long-handled collander, wire basket or cloth bag; immerse product in rapidly boiling water; begin counting the cooking time from the time when the water again comes to a full rolling boil; blanch for the required period of time. During the blanching period agitate the vegetable by moving the container up and down in the boiling water. The length of blanching time and preparation are given in Table I. For steam blanching, use a very large kettle of six- to twelve-quart capacity which has a tight fitting cover and can be fitted with a wire rack and basket. One to two quarts of water are poured into the bottom of the kettle and the water brought to the boiling point. Then the produce is placed in the wire basket on the rack in the kettle and the vegetables are blanched in steam instead of being completely immersed in the boiling water. Blanching should be strictly limited to the necessary time if losses of vitamins and solids are to be reduced as much as possible.

A simple rough test for determining the accurate time for blanching is the so-called peroxide or catalase test, which consists of putting some pieces of the blanched tissues in a tumbler and adding hydrogen peroxide and noting whether bubbles of gas issue from the tissue pieces (Figure 3). If no bubbling is observed, the blanching is considered sufficient except for some products like corn, which do not respond in a uniform manner to this test. Another simple test is adding to a cut surface of the plant tissue a drop of benzidine (1 per cent in 50 per cent alcohol solution) and a drop of hydrogen peroxide of 12 volume strength. The development of a blue tint indicates that the vegetable has not been sufficiently blanched.

The necessity for prompt handling between harvesting and freezing is very important. If this period is prolonged, freshness is lost, vitamins are at least partially destroyed, bacteria multiply, and other changes occur. If delays at any stage of preparation are unavoidable, the product should be kept as cool as possible short of freezing. This is especially important in the case of vegetables after they are blanched. The moisture and broken surfaces offer ideal conditions for the growth of bacteria, and vitamin losses increase rapidly. Chilling the vegetables in water after blanching should be done quickly in order to avoid further losses of soluble materials such as vitamin C, thiamine, minerals, etc. Many think it is necessary only to quick freeze vegetables in order to obtain a product of fair quality, but this is not entirely true. It is equally important, prior to freezing, to chill the vegetables rapidly down to the point where microorganisms grow very slowly and chemical and physiological changes are markedly retarded.

Vegetables are packed in containers immediately after cooling, with or without the addition of a brine solution. The advantages of using brine in packing vegetables are that it eliminates drying out when the container is not vapor-proof, helps some soft foods such as asparagus, broccoli and cauliflower to hold their shape after blanching, protects food before being carried to the locker, and prevents thawing while being brought back home. Disadvantages of packing with brine are the

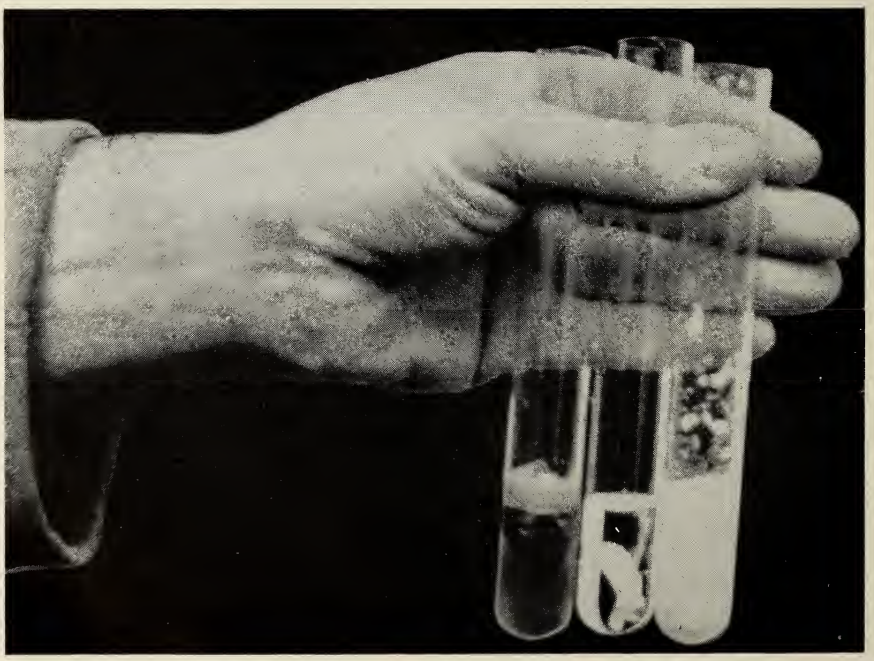

FIGURE 3. Test for Catalase (in the Right) and Peroxidase (in the Left) in order to Find the Proper Time for Blanching. In the Middle, Plant Tissue Well Blanched; It Neither Produces Foam with Hydrogen Peroxide (As the Right Tube) Nor Turns Blue with Benzidine (As the Left Tube).

extra work in preparation, the added weight of the packages, the danger of causing packages, especially jars, to break while freezing, and the need of thawing before cooking. In general, there are only slight differences in most vegetables packed with or without brine. Corn cut from the cob and packed in brine is superior to that packed dry. Green beans and wax beans are likely to split when packed in brine. To prepare a brine solution, add one teaspoon table salt to each cup of water, making the solution approximately two per cent. Too much salt causes the vegetable to become tough. Pack the vegetable into the container and then add enough brine to cover, allowing a headspace for expansion of the liquid on freezing.

After bringing vegetables home from the locker they should be kept in the freezing compartment of a refrigerator until just before they are cooked. Spoilage is likely to occur very quickly in thawed, uncooked vegetables.

Additional Notes on the Preparation of Specific Vegetables

Corn.—Usually a better product is obtained if the corn is cut from the cob, but it may be frozen cream style, whole kernels or on the cob. For corn on the cob, wrap each ear separately in moisture-vapor-proof paper or cellophane. Freeze and then pack into containers.

Pumpkin.—When pumpkin is to be used for pies, it is preferable to cook, mash and add sugar, honey or syrup to taste.

Spinach.—The best varieties for freezing are the Savoy type, but broadleaf varieties such as Nobel may be used. To be suitable for freezing, the spinach should have a deep green color, no yellow leaves, short stem, and pleasing flavor and odor after cooking. It should be cut before flowers appear.

Sweet or Bell Peppers.—Use uniformly green varieties of glossy skin, thick flesh, tender texture, and characteristic flavor. Washing and halving or slicing are all that is required. Blanching is not necessary. The use of 2 per cent brine seems to improve the quality.

Sweet Potatoes.—Bake or boil potatoes until soft. Cool, peel and slice. Dip in a solution of one part of lemon juice to eight parts of water. Drain, roll in sugar, pack, and freeze. Sweet potatoes may also be frozen in the puree form.

PREPARATION OF FRUITS FOR FREEZING

Fruits for frozen pack should be soft ripe but not mushy. Apples should be ripe but not soft ripe, since steaming softens the slices. For the preparation of fruit for freezing, peel, pit, slice or otherwise prepare the fruit for table use and keep cool until ready for the sugar or sugar syrup. It is not necessary to use moisture-proof cartons for storage of fruits as for vegetables, but it is essential that cartons for freezing fruit be water tight. Wash fruit thoroughly in cold water, preferably containing ice, as this keeps the fruit firm. When a large quantity of fruit is to be frozen, it is better to prepare it in several lots so that there will be no delay between the various steps.

Sugar or sugar syrup is added to fruit for two reasons: The coating of syrup (prepared syrup or syrup formed from juice and sugar) pro-

tects fruit exposed to the air from oxygen, which hastens enzymic action. It also checks the action of enzymes in the fruit during the storage period. Dry sugar is added to those fruits which form juice, and syrup is added to the less juicy ones. When sugar is used, it is added to the fruit and mixed by rotating the container or gentle stirring until all the sugar is wet, then packed. Syrup is added after the fruit has been packed, allowing headspace for expansion on freezing.

Syrups recommended for fruits to be frozen are:
40 per cent syrup—$2\frac{3}{4}$ cups sugar, 1 quart water.
50 per cent syrup—4 cups sugar, 1 quart water.
60 per cent syrup—$6\frac{1}{4}$ cups sugar, 1 quart water.
65 per cent syrup—$7\frac{3}{4}$ cups sugar, 1 quart water.

Hot water may be used to dissolve the sugar, but the syrup should be cool, preferably chilled, before it is used. One gallon of syrup is sufficient for approximately 40 one-pound packages.

Apples.—Two methods are in general use for the prevention of darkening of apples. They may be blanched or they may be treated with sodium sulfite. Peel and slice as for pies. For blanching, slice apples into cold water containing one teaspoon salt per cupful, until enough is prepared for five or six containers. Blanch the slices one and one-half to two minutes in steam or boiling water as directed for vegetables.

The other method of preparing apples for freezing employs sodium sulfite, which can be bought at the drugstore. Add one tablespoon sodium sulfite to a gallon of water and soak the apple slices for five minutes. Never use iron or copper containers and do not allow the solution to stand in the utensil after use.

Apples may be packed without sugar or with one part of sugar to four parts of fruit. Cooked apples or applesauce prepared to serve may also be frozen.

Blackberries or Dewberries.—These should be picked well ripe because the immature fruit tends to turn red on freezing and upon thawing remains hard. They are packed with 60 or 65 per cent syrup or one part of sugar to four parts of berries.

Figs.—Pack whole or sliced with 40 per cent or lighter syrup.

Juices.—Sweetened fruit juices are usually packed in enamel lined cans or glass jars or bottles. Allow ample headspace for expansion on freezing; otherwise the containers may break.

Peaches.—This fruit may be peeled by immersion in boiling water or by steaming for 15 to 30 seconds, or it may be lye peeled followed by immediate cooling in water. Unripe peaches will not peel easily under these conditions, are likely to become hard and bitter when frozen and thawed, and are more susceptible to browning. Sliced peaches are preferable to halves because of better penetration of sugar into the fruit and ease of packing container. If lye peeling is used or there is some delay in completing the freezing process, it is best to drop the peeled fruit into a weak citric acid solution (three-fourths cup lemon juice or two teaspoons citric acid per gallon of water). If this is not available, a weak salt solution helps to prevent browning during a delay. Peaches are packed with 60 to 70 per cent syrup.

The use of a 0.2 per cent ascorbic acid (vitamin C) in the syrup retards browning of peaches when they are thawed. Add one and one-half teaspoons crystalline or 8.5 grams in tablet form (thirty-five 250 milligram tablets) dissolved in a small amount of water to one gallon of cold syrup. It is possible to keep the syrup containing ascorbic acid over a period of 48 hours if it is refrigerated and not unduly exposed to air or contaminated with iron or copper.

Recommended varieties for this locality are Elberta, Hale, Belle of Georgia, Early Elberta and Hiley.

Pineapple.—Cut in wedges, slices or cubes and pack with 40 per cent syrup.

Strawberries.—Firm varieties of deep color, good texture, and rich flavor should be used. Of the locally grown varieties, Konvoy, Klondike, and Klonmore have proved quite satisfactory. They may be packed whole or sliced, but slicing gives the better product because of better penetration of sugar into the berries. Pack with one part of sugar to four or five of berries. Whole berries may be packed with 60 per cent syrup.

OTHER PRODUCTS

Eggs.—Eggs are always broken before freezing. They may be put up as whole eggs, yolks alone or whites alone. Whole eggs or yolks are stirred gently to avoid whipping in air, and one teaspoon salt or one tablespoon corn syrup, honey or sugar added to two cups of eggs or yolks. Egg whites are not stirred or treated before freezing. Pack in small containers so that the whole amount of eggs will be used at one time. One measuring cup will hold about five whole eggs, twelve yolks, or eight whites. Thawed egg whites may be stored in the refrigerator for several days, but thawed yolks can be stored only 48 hours.

Dairy Products.—Milk, cream, butter and cheese may be frozen if moisture-vapor-proof packaging material is used. Cheese should not be held longer than six months. On thawing, cheese shows a definite tendency to dry out rapidly.

Fish.—Fish are almost always contaminated by bacteria within a few hours after they are caught, and spoilage begins early, since organisms which attack fish normally live at low temperatures as compared with those which attack fruits and vegetables. In spite of this fish can be kept for several months in a condition almost as good as when they are fresh caught if they are frozen in the fresh condition and kept at 0° F. Fish should be placed on ice or in a refrigerator as soon as possible after catching. In any case, fish should never be allowed to become warm. Fish should be cleaned and prepared for cooking, then immersed in brine (one cup of salt to one gallon of water) for 20 to 30 seconds before being packed into containers or wrapped in moisture-vapor-proof material. Glazing, or coating with ice, may be done at the freezer locker plant.

Oysters, clams and scallops merely require washing in brine (one-half cup salt to one gallon of water) as preparation for freezing.

Crabs and lobsters should be cooked, cooled, and only the meat frozen.

Shrimp are always headed and may be frozen raw or cooked, with or without shell. Boil in water containing salt and any seasoning desired

for eight to ten minutes. They may be packed dry, with cocktail sauce, or as Shrimp Creole.

Meat.—In general there are two groups of meat, those that should be chilled immediately after killing, such as pork and game, and those that should be allowed to tenderize five to fourteen days between the time of chilling and freezing, as beef and mutton.

Meat to be frozen should come from disease-free animals and be handled in a sanitary manner, as clean meat keeps better. The freshly slaughtered carcass should be chilled promptly to a temperature just above freezing within the first 24 hours. Pork should be cut and frozen immediately after it has been chilled. Veal should be cut and frozen the third day. Beef and lamb will be more tender if allowed to hang in a chilled room for about a week. The length of time meat and poultry will retain good flavor depends upon the temperature of freezing and storage and the kind of meat as given in Table 2.

TABLE 2. MAXIMUM HOLDING PERIODS FOR VARIOUS MEATS*

Kind of Meat	*Maximum Holding Period*	
	at —10° F.	*at 0° F.*
Pork	1 year	8 months
Beef	1½ year	1 year
Lamb	1½ year	1 year
Veal	1 year	8 months
Poultry and game	1 year	8 months

* Lydia Tarrant, H. H. Kauffman, and P. Thomas Ziegler, *Freezing Meat and Poultry for Home Use,* Pennsylvania Agricultural Extension Service Circular 251, January, 1944.

For fresh tasting meat the storage period should be limited to half the maximum storage period. Storage of fat meat at 10° F. and 15° F. results in creating a rancid taste after three to five months storage.

The methods of wrapping meat are given under Containers, page 5. In the case of steaks and chops it is well to place waxed paper between the pieces of meat to facilitate easy separation before thawing. The removal of most of the bone in meat conserves wrapping material and storage space.

Poultry.—Poultry should be dressed and drawn and prepared for cooking. The birds may be cut in pieces or left whole for roasting, depending on the size and use to be made of them. Necks and backbones from several birds may be frozen together to be used for soup stock. The giblets are wrapped in locker paper and placed in the body cavity of carcasses for roasting. Poultry is wrapped in moisture-vapor-proof material according to directions given for meat. Cartons may be used for cut pieces. Poultry must be used immediately after thawing.

LABELING

All articles of frozen food should be labeled plainly, giving the contents of package, date and any other useful information. It is helpful to give the cut or type of meat and poultry and the approximate weight. Gummed labels are likely to come off, and ink will run because of contact with moisture. A china-marking pencil or ordinary color crayon is useful for labeling packages of frozen foods.